

WHAT IS CLAIMED IS:

1. An analytical device comprising an electrochemical cell and a sample containment device,

5 said electrochemical cell comprising:

an anodic reservoir adapted to receive an electrolyte;

a cathodic reservoir adapted to receive an electrolyte;

a connection between said anodic reservoir and said cathodic reservoir for permitting communication of electrolyte from at least one of said reservoirs to the other
10 of said reservoirs;

a first bubble-free electrode disposed within one of said anodic reservoir and said cathodic reservoir;

a second electrode disposed within the other of said anodic reservoir and said cathodic reservoir;

15 a power source having a positive terminal that is normally in electrical contact with said first electrode, and a negative terminal that is normally in electrical contact with said second electrode, said electrochemical cell operating in an electrolytic mode and generating an electrical field when said power source is turned on and said cell is operating in a normal mode of operation; and

20 a power source polarity inverting device for switching the contacts between the terminals of said power source and said first and second electrodes such that said negative terminal is in electrical contact with said first electrode and said positive terminal is in electrical contact with said second electrode;

said sample containment device comprising a sample containment chamber, said sample containment chamber including an opening for introducing a sample into said chamber and being positioned with respect to said electrochemical cell such that an electrical field generated by said electrochemical cell can influence at least one property of at least one component of a sample disposed in said sample containment chamber.

2. The analytical device of claim 1, wherein said at least one property comprises the mobility of said at least one component.

3. The analytical device of claim 1, wherein said at least one property comprises the rheology of said at least one component.

4. The analytical device of claim 1, wherein said at least one property comprises the viscosity of said at least one component.

5. The analytical device of claim 1, wherein said second electrode is a bubble-free electrode.

6. The analytical device of claim 1, wherein at least one of said first and second electrodes comprises a palladium metal material.

7. The analytical device of claim 1, wherein both of said first and second electrodes comprise a palladium metal material.

8. The analytical device of claim 1, wherein at least one of said first and second electrodes comprises a nickel hydroxide material.

9. The analytical device of claim 8, wherein said nickel hydroxide material includes a nickel hydroxide compound of the formula $\text{Ni}(\text{OH})_x$ wherein x is 2 or 4.

10. The analytical device of claim 1, wherein both of said first and second electrodes comprises a nickel hydroxide material.

11. The analytical device of claim 10, wherein said nickel hydroxide material includes a nickel hydroxide compound of the formula $\text{Ni}(\text{OH})_x$ wherein x is 2 or 4.

12. The analytical device of claim 1, wherein at least one of said first and second electrodes comprises a nickel-cadmium electrode system.

5 13. The analytical device of claim 1, wherein at least one of said first and second electrodes comprises an ionic liquid.

14. The analytical device of claim 1, wherein at least one of said first and second electrodes comprises an ionic conductor selected from liquid electrolytes, gels, polymer electrolytes, ceramics, glasses, membranes, and combinations thereof.

10 15. The analytical device of claim 1, wherein at least one of said first and second electrodes is connected said power source and said power source comprises an alternating current power supply.

16. The analytical device of claim 1, wherein said sample containment device comprises an electrophoretic device.

15 17. The analytical device of claim 1, wherein said sample containment device comprises an electroosmotic device.

18. The analytical device of claim 1, wherein said electrochemical cell operates in a galvanic mode when said power source polarity inverting device switches the contacts between the terminals.

20 19. The analytical cell of claim 1, wherein said power source produces from greater than 5 volts to about 200 volts.

20. An electrochemical cell comprising:
an anodic reservoir adapted to receive an electrolyte;

a cathodic reservoir adapted to receive an electrolyte;

an electrical connection between said anodic reservoir and said cathodic reservoir for permitting communication of electrolyte from at least one of said reservoirs to the other of said reservoirs;

5 a first bubble-free hydrogen absorbing electrode disposed within one of said anodic reservoirs and said cathodic reservoir;

a second electrode disposed within the other of said anodic reservoir and said cathodic reservoir;

10 a power source having a positive terminal that is normally in electrical contact with said first electrode, and a negative terminal that is normally in electrical contact with said second electrode; and

a power source polarity inverting device for switching the contacts between the terminals of said power source and said first and second electrodes such that said negative terminal is in electrical contact with said first electrode and said positive
15 terminal is in electrical contact with said second electrode.

21. The electrochemical cell of claim 20, wherein said second electrode is a bubble-free hydrogen absorbing electrode.

22. The electrochemical cell of claim 20, wherein at least one of said first and second electrodes comprises a palladium metal material.

20 23. The electrochemical cell of claim 20, wherein both of said first and second electrodes comprise a palladium metal material.

24. The electrochemical cell of claim 20, wherein at least one of said first and second electrodes comprises a nickel hydroxide material.

25. The electrochemical cell of claim 24, wherein said nickel hydroxide material includes a nickel hydroxide compound of the formula $\text{Ni}(\text{OH})_x$ wherein x is either 2 or 4.

26. The electrochemical cell of claim 20, wherein both of said first and second
5 electrodes comprises a nickel hydroxide material.

27. The electrochemical cell of claim 26, wherein said nickel hydroxide material includes a nickel hydroxide compound of the formula $\text{Ni}(\text{OH})_x$ wherein x is either 2 or 4.

28. The electrochemical cell of claim 20, wherein at least one of said first and
10 second electrodes comprises a nickel-cadmium electrode system.

29. The electrochemical cell of claim 20, wherein at least one of said first and second electrodes comprises an ionic liquid.

30. The electrochemical cell of claim 20, wherein at least one of said first and second electrodes comprises an ionic conductor selected from liquid electrolytes, gels,
15 polymer electrolytes, ceramics, glasses, membranes, and combinations thereof.

31. The electrochemical cell of claim 20, wherein at least one of said first and second electrodes comprises is connected to an alternating current power supply.

32. The electrochemical cell of claim 20, wherein said electrochemical cell operates in a galvanic mode when said power source polarity inverting device switches
20 the contacts between the terminals.

33. The electrochemical cell of claim 20, wherein said power source produces from greater than 5 volts to about 200 volts.

34. An analytical device comprising the electrochemical cell of claim 20 and a sample containment device.

35. The analytical device of claim 34, wherein said sample containment device comprises an electrophoretic device.

5 36. The analytical device of claim 34, wherein said sample containment device comprises an electroosmotic device.

37. A method of separating at least one component from one or more other components in a sample, said method comprising:

providing the analytical device of claim 1;

10 loading a sample having multiple components in the sample containment device of the analytical device; and

operating the electrochemical cell of the analytical device to generate a field that affects separation of at least one of the components of the sample from at least one other component in the sample.

15 38. A method of separating at least one component from one or more other components in a sample containing multiple components, said method comprising:

providing an electrochemical cell of claim 20;

operating the electrochemical cell to generate a field; and

20 using the generated field to affect separation of at least one of the components of the sample from at least one other component in the sample.

39. A method of influencing at least one property of at least one component in a sample, said method comprising:

providing the analytical device of claim 1;

loading a sample having a component in the sample containment device of the analytical device; and

operating the electrochemical cell of the analytical device to generate a field that influences at least one property of the component of the sample.

5 40. A method of influencing at least one property of at least one component in a sample, said method comprising:

providing an electrochemical cell of claim 20;

operating the electrochemical cell to generate a field; and

10 using the generated field to influence at least one property of the component of the sample so as to manipulate the component.

 41. A method of preparing a bubble-free electrode for bubble-free operation under electrolytic conditions, said method comprising:

providing the analytical device of claim 1 wherein said bubble-free electrode comprises a hydrogen-absorbing material;

15 actuating said power source polarity inverting device for switching the contacts between the terminals of said power source and said first and second electrodes such that said negative terminal is in electrical contact with said first electrode and said positive terminal is in electrical contact with said second electrode;

20 pre-charging the bubble-free electrode by operating said electrochemical cell under conditions of reverse polarity relative to normal operation of the cell, said pre-charging being conducted under sufficient electrical conditions and for a sufficient time to produce and store hydrogen at the electrode which operates as an anode under normal operating conditions of the electrochemical cell; and

subsequent to pre-charging, operating the electrochemical cell in a normal mode of operation such that hydrogen stored at the anode reacts with oxygen gas formed at the anode under normal operating conditions to thereby prevent or reduce formation of oxygen gas bubbles at said anode.

5 42. The method of claim 41, wherein said electrode that operates as an anode under normal operating conditions comprises a palladium material.

43. A device for separating components of a sample, comprising:

a channel defined at least in part by one or more inner walls;

a flow generating device for generating a flow of flow medium through said

10 channel;

an electrode pair including at least one electrode disposed at or adjacent said one or more inner walls;

a power supply for supplying said electrode pair with a power supply of sufficient voltage and/or current to form an electric field that extends between the electrode pair in

15 a direction that is transverse to the direction of flow; and

a controller for controlling said power supply to move charged components of said sample in a direction that is transverse to said direction of flow.

44. The device of claim 43, wherein said flow generating device is an electrophoretic flow-generating device.

20 45. The device of claim 43, wherein said flow-generating device is a pressure-driven flow-generating device.

46. The device of claim 43, wherein said controller controls said power supply so that at least one of said electrodes captures one or more components from said flow.

47. The device of claim 43, wherein at least one electrode of said electrode pair is a bubble-free electrode.

48. The device of claim 43, wherein both electrodes of said electrode pair are bubble-free electrodes.

5 49. The device of claim 43, further comprising an electrophoretic field-generating pair of second electrodes wherein said second electrodes are disposed at or adjacent opposite ends of said channel, respectively.

50. The device of claim 49, wherein at least one of said second electrodes is a bubble-free electrode.

10 51. The device of claim 49, wherein both of said second electrodes are bubble-free electrodes.

52. A method of separating components of a sample, comprising:
providing a channel at least partially defined by one or more inner walls;
causing a flow of flow medium through said channel in a direction of flow, said
15 flow having a flow profile including regions of faster flow and regions of slower flow;
disposing a sample having components to be separated in said channel such that said sample is carried by said flow medium in the direction of flow;

providing an electrode pair and disposing at least one electrode of said pair at or adjacent said one or more inner walls;

20 supplying said electrode pair with a power supply of sufficient voltage and/or current to form an electric field that extends between the electrode pair in a direction that is transverse to the direction of flow; and

controlling said power supply to move charged components of said sample in a direction that is transverse to said direction of flow to change the position of one or more of said charged components in said flow from a region of a first speed to a region of a second speed that differs from said first speed.

5 53. The method of claim 52, wherein said flow of flow medium is a pressure-driven flow.

 54. The method of claim 52, wherein at least one electrode of said electrode pair is a bubble-free electrode.

 55. The method of claim 52, wherein both electrodes of said electrode pair are
10 bubble-free electrodes.

 56. A method of separating components of a sample, comprising:
 providing a channel at least partially defined by one or more inner walls;
 causing a flow of flow medium through said channel in a direction of flow, said
flow having a uniformly cross-sectioned flow profile;

15 disposing a sample having components to be separated in said channel such that
said sample is carried by said flow medium in the direction of flow;

 providing an electrode pair and disposing at least one electrode of said pair at or
adjacent said one or more inner walls;

 supplying said electrode pair with a power supply of sufficient voltage and/or
20 current to form an electric field that extends between the electrode pair in a direction that
is transverse to the direction of flow; and

 controlling said power supply to move charged components of said sample in a
direction that is transverse to said direction of flow, and to hold the position of one or

more of said charged components in said flow to affect a concentrating of a charged component at an electrode.

57. The method of claim 56, further comprising controlling said power supply to capture components at one or both of the electrodes of said electrode pair.

5 58. The method of claim 57, further comprising releasing captured components from one or both electrodes of the electrode pair into the flow.

59. The method of claim 56, wherein said flow of flow medium is a pressure-driven flow.

60. A sample separation device including an electrochemical cell, said
10 electrochemical cell comprising an electrode that acts as an anode during normal operation of the cell, and an electrode that acts as a cathode during normal operation of the cell, wherein, the cell has been pre-charged such that the normally-operating anode has absorbed hydrogen and can run bubble-free for a period of time under normal electrolytic operating conditions.

15 61. The device of claim 60, wherein said electrode that acts as an anode during normal operation of the device does not generate oxygen bubbles visible to the naked eye under conditions of a current density held at about 72 A/m^2 for about 1.0 second in a degassed solution under conditions of ready-nucleation.

20 62. A palladium anode that does not generate oxygen bubbles visible to the naked eye under conditions of a current density held at 72 A/m^2 for one second in a degassed solution under conditions of ready-nucleation.

63. An electrochemical cell including the palladium anode of claim 62.

64. A sample separation device including the electrode of claim 62.

65. An electrophoretic device including the palladium anode of claim 62.

66. An analytical device comprising:

a flow pathway;

a flow manipulating cell adjacent said flow pathway, said flow

manipulating cell including a confined reservoir, an exit port in communication with the
reservoir, and a pressure generating electrode in said reservoir, said pressure generating
electrode generating gas bubbles within said reservoir for increasing pressure within the
cell; and

a pressure relief pathway in communication with said flow pathway for
affecting a flow through said flow pathway.

67. The analytical device of claim 66, wherein said pressure-generating
electrode is a palladium electrode.

68. The analytical device of claim 66, wherein said pressure-generating
electrode is a palladium anode that runs bubble-free for a time period of at least about 1.0
second when held at a current density of about 72 A/m^2 in a previously degassed solution
under conditions of ready-nucleation.

69. The analytical device of claim 66, wherein said flow pathway includes an
electrophoretic separation channel.

70. The analytical device of claim 66, wherein said exit port includes a
frangible seal.

71. The analytical device of claim 70, wherein said frangible seal is heat-
meltable and in communication with a heating element.